

FOUNDATIONAL STAGES OF MATHEMATICAL THINKING

Developing “Number Sense”

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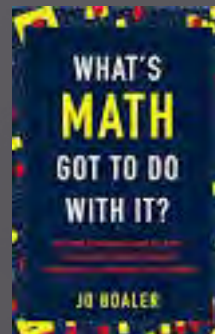
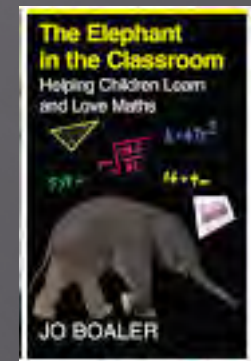


Goals for Today:

- ▣ Examine research regarding the importance of the development of “foundational number sense” in the primary classroom.
- ▣ Explore two models for the landscape of the development process in primary mathematics.
- ▣ Introduce Number Talks as a number sense development strategy you can incorporate in your classroom on Monday.

The “Why?”

- Jo Boaler, Professor of Mathematics Education, Stanford University:



- <http://www.youtube.com/watch?v=YFqaMmKRYIQ>



Research Results that Transform Mathematical Learning

- Learning Substantial Math is Critical for Primary Students
 - (Duncan, et al. in press)
- All Students Can Achieve at High Levels
 - (Maguire, et al, 2000) (Today, 2010) (Karni, et al 1998)
- Students' Ideas about their Ability (mindset) Determine their Learning Pathways and Math Achievement
 - (Dweck, 2006) (Blackwell, 2010)
- Mistakes and Struggle are Extremely Important for Learning
 - (Engle, 2002)
- Teachers Messages are Hugely Powerful
 - (Dweck, 2006) (Boaler, 2013)
- Teachers' Understanding of Mathematical Development Increases Student Achievement in all Learning Areas
 - (Hill & Ball, 2005)



Primary Students' Math Development – What Research Tells Us

- Sequences of development typically occur slowly through ages 4 to 9
- These sequences will differ from one child to the next
- Although these sequences are shown in “linear” and “boxed” formats in many study results, this is not to suggest that young children’s mathematical learning is necessarily “linear” and/or “discrete”
 - NYC Public Schools Manual Handout (2006)
- Twomey Fosnot and Dolk use the term “landscape” to describe the complexity of children’s learning pathways (2001)



Student Interview

<http://educationnorthwest.org/content/1104>

Think About These Questions and Discuss at your Table:

- Where does this student fall on the Mathematical Landscape?
- Where would you go next with this student?



Procedural Thinking vs. Conceptual Thinking

$$326 + 127$$

1st Grade Number Talk

http://www.youtube.com/watch?v=blC9uX_8PY4

8 MATHEMATICAL PRACTICES

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning



NUMBER TALKS

Provide a purposeful vehicle for:

- ▣ Making sense of mathematics
- ▣ Developing flexibility with numbers
- ▣ Developing efficient strategies for solving problems
- ▣ Communicating mathematically – Classroom community
- ▣ Reasoning, analyzing others thinking, and proving solutions
- ▣ Building student confidence in mathematical reasoning, communication, and perseverance



Essentials For Number Talks

Select a location in the classroom where you have close proximity to your students:





Essentials For Number Talks

Take the time in the beginning to set and model expectations that will increase accountability:



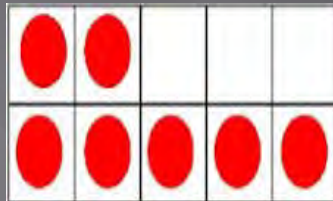
Essentials For Number Talks

Present a purposeful activity :

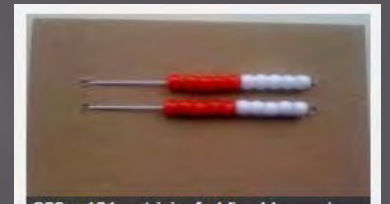
dot cards



ten frames



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Essentials For Number Talks

Provide appropriate wait time and expect all students to access the problem in some manner:



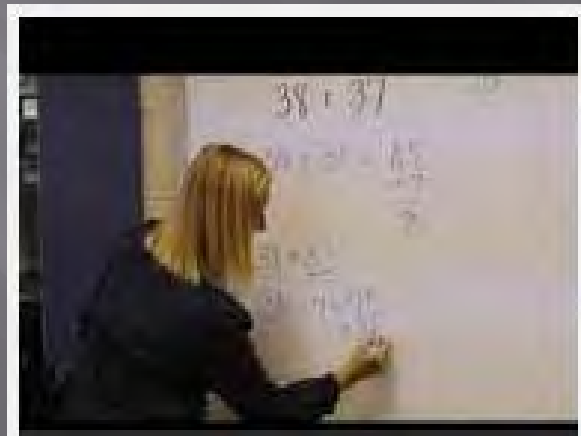
Essentials For Number Talks

Encourage student communication of their thinking throughout (proof) and accept, respect, and consider all answers:



Essentials For Number Talks

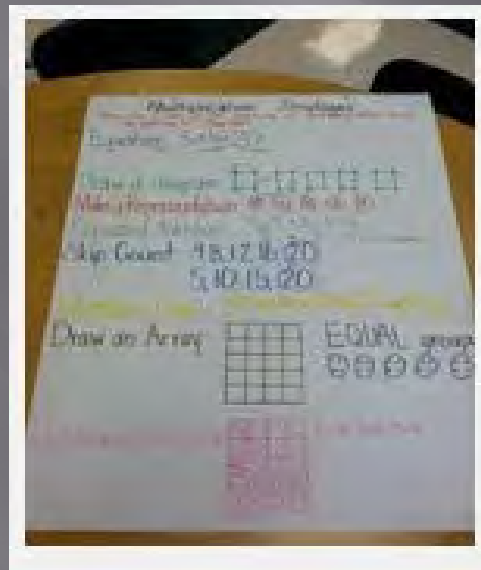
Provide a concrete model of student communication:





Essentials For Number Talks

Create and post class strategy charts:



Common Strategies for Addition

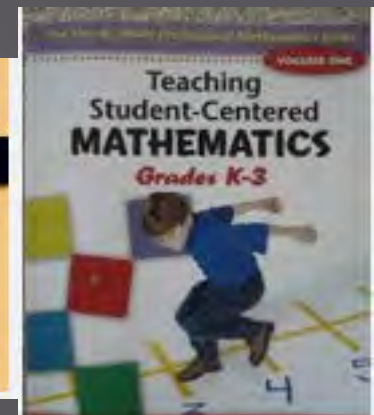
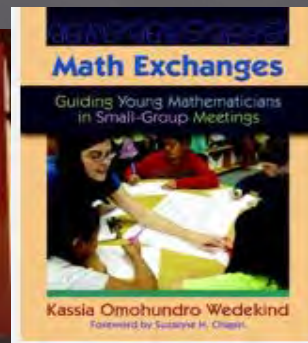
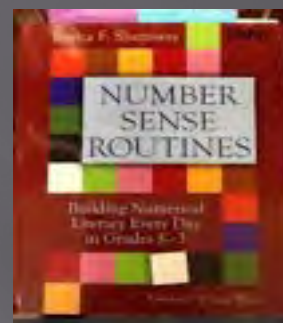
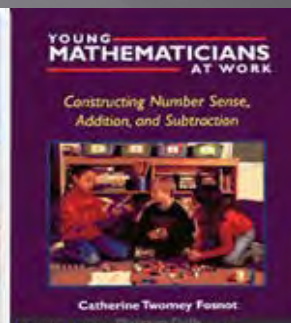
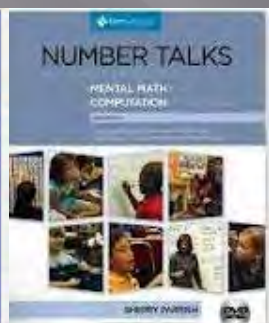
- ▣ Counting All:
- ▣ *Counting On:
- ▣ Doubles or Near Doubles:
- ▣ *Making Tens:
- ▣ Making a Friendly Number:
- ▣ *Compensation:
- ▣ Breaking Each Number into Place Value:
- ▣ Adding Up Chunks:

Subtraction Strategies

- ▣ ** Be sure to use an open number line when recording student thinking with these strategies.
- ▣ Adding Up:
- ▣ Removal or Counting Back:

“Students do not think as adults, and we should not teach them to think about mathematics as we do. Rather, we need to encourage them to use their own creative processes to “see it” for themselves.” Marilyn Burns

- <http://www.youtube.com/watch?v=kfHxzcZKq3E>



Access to The Assessments

Can be found:

NYC Manual:

<http://www.k-5mathteachingresources.com/support-files/ECAM-Manual-and-Resources.pdf>

Accessing Mathematical Understanding:

<http://educationnorthwest.org/content/2251?sid=9386>